

UNIVERSITÉ DE SHERBROOKE

Faculté d'éducation

L'impact de l'évaluation pré-clinique par les pairs en hygiène dentaire sur la performance à créer
deux restaurations composite de Classe II

The impact of peer-assessment on dental hygiene students' ability to create acceptable Class II
composite restorations

by

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Abstract

In dental hygiene accurate assessment of knowledge and skills is paramount. A substantial number of research has been devoted to self-assessment in the dental hygiene discipline whereas research on peer-assessment is lacking. The purpose of this study was to evaluate the impact of pre-clinical peer-assessment on the performance creating Class II composite restorations on tooth #15(MO) and # 46(MOD), including rubber dam and tofflemire and matrix band placements. Twenty second-year CEGEP dental hygiene students enrolled in Restorative Dentistry course participated in the study. The participants were randomly divided in control and experimental groups. At pre-tests, all 20 students were subject to a cognitive and procedural test Class II composite restoration on tooth # 45(MO) a week before the experiment. At post-test, participants performed two rubber dam, two tofflemire and matrix bands and two Class II composite restorations on tooth #15(MO) and # 46(MOD). Ten participants in the experimental group used the peer-assessment twice. A t-test was used to analyze the scores between the control and experimental groups. In order to understand the results, students' attitudes and perceptions regarding peer-assessment strategy were assessed using a five-point Likert scale and three open-ended questions from an anonymous online survey. Results indicated that there was no statistical significant difference between the two research groups on their ability to create Class II composite restorations on tooth # 15(MO) and # 46(MOD). Findings of this study suggest that more peer-assessment training and trials are needed in order to impact dental hygiene students' performance creating a Class II restoration.

Key words: dental hygiene education, peer-assessment, pre-clinical restorative dentistry, Class II restoration

Résumé

En éducation dans le domaine de l'hygiène dentaire, une évaluation précise des connaissances et des compétences est primordiale. En hygiène dentaire, un nombre important de recherches ont été consacrées à l'auto-évaluation, toutefois la recherche sur l'évaluation par les pairs fait défaut. Le but de cette étude était d'évaluer, l'impact de l'évaluation pré-clinique par les pairs, sur les performances d'insertions des restaurations en composites de Classe II sur les dents # 15(MO) et # 46(MOD) avec la mise en place de digues et de matrices sur porte-matrice tofflemire. Vingt étudiants en hygiène dentaire du cégep inscrits au cours de dentisterie restauratrice ont participé à l'étude. Les participants ont été répartis au hasard dans des groupes témoins et expérimentaux. Lors des pré-tests, tous les 20 étudiants ont été soumis à la création d'une restauration de type composite de Classe II, test cognitif et procédural sur la dent # 45 (MO), et ce, une semaine avant l'expérience. Au post-test, les participants ont réalisé deux mises en place de digues en caoutchouc, deux mises en place de matrice avec une porte-matrice de type Tofflemire et deux restaurations en composites de Classe II sur les dents # 15(MO) et # 46(MOD). Dix participants, du groupe expérimental, ont utilisé l'évaluation par les pairs, et ce par deux fois. Un test-t a été utilisé pour analyser les scores entre les groupes témoins et expérimentaux. Les résultats, les attitudes et les perceptions des élèves, concernant la stratégie d'évaluation par les pairs ont été évaluées à l'aide d'une échelle de Likert en cinq points et de trois questions ouvertes provenant d'un sondage en ligne anonyme. Les résultats ont indiqué qu'il n'y avait pas de différence statistiquement significative entre les deux groupes de recherche sur leur capacité à créer des restaurations composites de Classe II sur les dents # 15(MO) et # 46(MOD). Les résultats suggèrent qu'une meilleure formation des pairs-évaluateurs et une

augmentation des fréquences d'évaluation par les pairs pourraient améliorer la performance des élèves en hygiène dentaire.

Mots clés: éducation en hygiène dentaire, évaluation par les pairs, dentisterie restauratrice pré-clinique, restauration de Classe II

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List of Abbreviations

JAC	JOHN ABBOTT COLLEGE
ID	Independent variable
DV	Dependent variable
DOPS	Direct Observation of Procedural Skills

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Introduction

Traditionally dental hygiene education has established a format within the curriculum based on laying a foundation designed to facilitate technical competencies in the laboratory and preclinical settings. This is accomplished early in the program by emphasizing the biological and clinical components in all areas of performance.

According to Canadian Dental Hygiene Association (CDHA) a dental hygienist is a clinical health professional who provides preventive, therapeutic and supportive clinical therapy that contributes to the clients' oral and general health (CDHA, 2010). L'Ordre des hygienistes dentaire du Québec cites as one of the delegated acts of a dental hygienist, the authority to insert and sculpt restorative materials and place temporary fillings, without drilling, when the pulp is not exposed (OHDQ, 2011).

The primary aim of the restorative dentistry course is to ensure the competency of dental hygiene clinicians (students) who can demonstrate adequate skill, knowledge and take responsibility for providing effective care to patients who need restoration of tooth structure. Students will develop psychomotor, procedural skills that are necessary to restore teeth to their proper anatomical shape and function.

Furthermore, the Canadian Dental Hygiene Association (CDHA) mandates the development of dental hygienists who are self-directed, life-long learners and reflective practitioners. The establishment and guarantee of quality patient care comes through perseverance and being a reflective practitioner, one who can identify and articulate strengths as well as areas in need of improvement in themselves, their team, and crucially their peers. The ability to peer evaluate is unambiguously documented as an essential and fundamental outcome and competency of medical graduates. However, we know little about how this competency is developed among

dental hygiene students. More importantly, we need to know how this competency to evaluate peers is related to the person giving the feedback and the person receiving the feedback.

This study examined whether the peer-assessment strategy enhanced students' ability to create an acceptable Class II restoration in the pre-clinic/laboratory section of the Restorative Dentistry course. A quasi-experimental design was chosen for this study. Quantitative and qualitative data were collected and analyzed in order to determine if peer-assessment was beneficial in creation of Class II composite restorations on tooth # 15(MO) and # 46(MOD).

It is hoped that, should the study conclude that the peer-assessment strategy is efficacious the finding would be used to make recommendations to the Dental Hygiene Program at John Abbott.

Chapter 1: ProblemStatement

The purpose of this study was to investigate the impact of peer- assessment on fourth semester dental hygiene students' ability to create acceptable Class II restorations on tooth # 15(MO) and # 46(MOD) in the pre-clinic/laboratory section of the Restorative Dentistry course offered at John Abbott College.

This semester was my third-time teaching Restorative Dentistry. In my second year of teaching this course I noticed that even after reflective self-evaluation students had difficulties creating an acceptable Class II restoration. This might be attributed to the fact that the first year of the dental hygiene program focuses on the theoretical aspects of the curriculum as opposed to the development of psychomotor skills. In second year, students combine practical courses such as restorative dentistry with their theoretical knowledge, to help them become competent in patientcare. The preclinical restorative dentistry course encourages the acquisition of visual and motor skills and some artistry requiring eye-hand coordination, spatial awareness, and the ability to visualize three-dimensional oral structures in fine detail. A key component of this course is to develop the students' conceptual, procedural, psychomotor and metacognitive skills required to restore teeth to their proper form and function.

The traditional way of learning restorative dentistry is to perform bench-type exercises on a typodont attached to a phantom-head (Dexter). In this laboratory part of the course students are required to complete 20 restorations which include two Class I, ten Class II, three Class III, one Class IV, and four Class V. These cavity preparations follow the dental caries on the tooth structure. Class I prep involves only the occlusal part of the upper and lower molars and premolars. Class II involves proximal surfaces (between the teeth) surfaces of the upper and lower molars and premolars. Class III includes all proximal surfaces of the upper and lower

anterior/front teeth. Class IV involves all proximal surfaces including the incisal edge of the upper and lower anterior teeth. Class V involves the cervical third of all teeth or surfaces closer to the neck of the tooth, close to the gingiva.

Restorative Dentistry is comprised of a one-hour theory portion and a three-hour lab. The course follows the most common teaching methodology of lecture (30%) followed by practical (70%). The assessment methodology includes three exams valued at 10% each (30%) and questions are a combination of multiple choice, short answer and diagrams. The weekly skills laboratory practical account for 45% and the final practical laboratory exam is valued at 25%. The practical self-assessment used in the weekly skills laboratory is formative. An instructional strategy that has not been utilized is peer-assessment.

In health education, accurate assessment of knowledge and skills is paramount. It is essential that students develop skills to critically evaluate their learning. In order to provide the best dental care, the learner not only has the responsibility to know what skills and knowledge s/he needs to obtain, but also how to judge his or her performance. A significant amount of research has been dedicated to self-assessment in the Dental Hygiene field (Mould, Bray & Gadbury-Amyot, 2011; Eva & Regehr, 2005; Fried, DeVore & Dailey, 2001) however there is little evidence-based research on peer-assessment.

A great deal of research on peer-assessment has been conducted with regard to medical (medicine, nursing) and dental (dentistry) education. According to this research peer-assessment has many benefits for the assessor and those being assessed. It encourages student's autonomy and higher order of thinking skills. Peer-assessment can enhance self-assessment. As students judge the work of their peer they gain insight into their own work (Topping, 1998; Boud & Falchikov, 2006; Falchikov & Goldfinch, 2000; Boud, Cohen & Sampson, 1999; Thomas,

Martin & Pleasants, 2011; Dochy, Segers & Slijmans, 1999; Bostock, 2000; Evans, Leeson & Petrie, 2007). When students peer-assess they are part of the assessment process and this will enhance motivation. Being able to practice evaluation skills will make them life-long learners and encourage them to become better self-assessors of their own learning (metacognition). This results in deep rather than surface learning (Bostock, 2000).

The ability to assess one's own practice is essential in dental hygiene to ensure a successful outcome; however self-assessment alone has proven insufficient in past practice sessions when assessing Class II restoration in the Restorative Dentistry course in the dental hygiene program at JAC. Hence, I suggested that fostering pre-clinical peer-assessment could enhance student' learning in the restorative course. The use of peer-assessment in the clinical/laboratory setting has been extensively encouraged (Iwasiw & Goldenberg, 1993; Dochy et al., 1999; Bostock, 2000; Thomas, Martin & Pleasants, 2011; Evans, Leeson & Petrie, 2007; Casey et al, 2011; Chen, 2012; El-Mowafy, 2014; Tricio, Woolford & Escudier, 2015).

That is why the present study sought to evaluate the impact of peer-assessment in students' ability to create acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD).

Chapter 2: Conceptual Framework

Dental health education involves a variety of teaching strategies and activities to assure student learning. These strategies involve higher levels of thinking and require students to use cognitive, psychomotor, affective and metacognitive skills. At John Abbott College peer and self-assessment are vital components of learning and developing decision making and critical thinking abilities in the practice of dental hygiene. The American Dental Education Association (ADEA), American Dental Hygienists' Association (ADHA), American Dental Association (ADA), and Commission on Dental Accreditation (CODA) has acknowledged that critical thinking is required for dentists and dental hygienists (O'Kelly Wetmore, Boyd, Bowen & Pattillo, 2010). Critical thinking is an essential skill of any health care provider (Johnsen, Lipp, Finkelstein & Cunningham-Ford, 2012; Pardamean, 2012). Critical thinking or as Dewey refers to as reflective thinking, is about making decisions about obstacles that dental students are faced with when offering dental care to their patients. In order to be carried out, reflective thinking requires several types of knowledge and skills such as declarative knowledge, procedural knowledge, psychomotor abilities or skills and metacognitive knowledge (Boyd, 2002).

Students in the restorative course have acquired declarative knowledge in the first three semesters through lectures and reading books in other courses, such as Prosthodontics, Periodontal Instrumentation, and Dental Anatomy. However, declarative knowledge is insufficient for skilled performance. Students are required to learn procedures and techniques on how to use this knowledge. This is called procedural knowledge. An example of this is the creation of a restorative filling. Students have learned and seen in power points and text books (e.g. G.V. Black's cavity preparations), different restorative material such as acid etch, prime, bond, varnish, composite and amalgam. Using these materials for the first time is an

unforgettable experience for students and it provides them with a new understanding of tooth restoration. By applying their knowledge through these procedures, they not only understand the process better but enhance prior knowledge. Students are encouraged to reflect upon the conceptual basis for the procedures that they are performing, which facilitates their learning (Boyd, 2002).

Students have knowledge of the theory of instrument design and how to correctly hold an instrument. In the restorative course students learn about and practice with new instruments such as condensers, placement instruments, carvers, and high and slow speed hand piece that are used for inserting, condensing and creating tooth anatomy. Although handling restorative instruments is easier than grasping periodontal instruments that are required to debride teeth, students tend to have some difficulty resulting in the creation of an unacceptable Class II restoration. Through my class demonstration and instruction on handling the instruments while I perform a Class II restoration on typodont, students begin to receive declarative knowledge about the motor skill. Another teaching instruction is restorative video explaining all the steps involved and YouTube videos. During the cognitive stage of learning student think about what is required to perform the motor task (Schmidt & Lee, 1999). Smith and Ragan states “all instruction is part of education because all instruction consists of experiences leading to learning” (Smith & Ragan, 1999, p. 4). These instructional practices in career programs can be regarded as training where students learn skills that they will use almost immediately.

As students apply declarative and procedural knowledge through training and practicing on typodont their metacognition process is activated. Metacognitive knowledge or thinking about thinking helps students to assess the situation and adjust their attention and action accordingly (Boyd, 2002). When, while creating a restoration on a mannequin, students forget a step, a

procedure, or when a particular motor skill is not applied correctly they should stop and question the consequences. What would happen to a real person's tooth? What are the ramifications? This is when metacognition takes place. Actively knowing the consequences of what happens when procedures are not followed accordingly during tooth restoration. They must consider the possibility of recurrent decay, root canal or tooth loss. Students in the preclinical restorative course apply principles of restoring teeth to their natural functions on bench-type exercises on a typodont attached to a phantom-head (Dexter). It is vital for students to develop motor and procedural skills necessary to restore teeth to their proper anatomy and function.

Restorative dentistry in our dental hygiene program consists of theory lecture, live demonstration in a laboratory setting, digital recourses and practical assignments (composite and amalgam restorations) on a phantom head (Dexter) comprised of a typodont with 32 plastic teeth embedded in soft pink simulated gingival tissue. The teeth to be restored have been pre-cut.

In the laboratory setting students were involved in the assessment process by performing self-assessment prior to teacher assessment. This teaching/learning strategy proved insufficient in past practice sessions when assessing Class II restorations. Peer-assessment was studied this semester. Peer-assessment enhances self-assessment and positively influences self-directed learning (Boud, 2001; Norcini, 2003). It is imperative that students develop the capacity to make judgements about their own work and that of others in order to become effective continuing learners and practitioners. To that end it is essential that students develop the capability of evaluating their work and the work of others (Boud, 2001). Similar results have appeared in research on higher education, in general, and on dental education, in particular (Kilic, 2016; Dochy et al., 1999; Manogue, Brown & Foster, 2001; Taylor, Grey & Satterthwaite, 2012; Chen, 2012; Tricio, Woolford, Lewis-Greene, Georghiou & Andiappan, 2015; Tricio, Woolford &

Escudier, 2015; Tuncer, Arhun, Yamanel, Çelik & Dayangaç, 2015; Evans, Leeson & Petrie, 2007). These researchers also investigated the benefits and challenges in performing peer-assessment in dental education.

From this research, I hypothesized that fostering formative peer-assessment in a restorative course will enhance students' ability to create an acceptable Class II restoration.

2.1 Variables

The independent variable: peer-assessment (IV) and the dependent variable: students' performance scores on two Class II composite restorations on tooth # 15(MO) and # 46(MOD) (DV).

2.2 Hypotheses

H.o. There will be no difference in the performance mean scores between the control group (no peer-assessment) and experimental group (peer-assessment) when creating acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD).

H.1. The peer-assessment will have significant positive impact on dental hygiene students' performance in creating acceptable class II composite restorations on # 15(MO) and # 46(MOD).

2.3 Research Question

1. Will peer-assessment significantly improve students' ability to create acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD)?

Chapter 3: Literature Review

Peer-assessment is based on philosophies of Piaget's active learning or cognitivism (information sharing, including insight, memory, perception, and meta-cognition), Cross's andragogy (self-actualization and continuing personal development) (Merriam, 2001), and Vygotsky's social constructivism, because it entails knowledge construction through dialogue and experience (Falchikov & Goldfinch, 2000), and andragogy (self-actualization and continuing personal development) (Merriam Caffarella, & Baumgartner, 2007), experiential learning, Bandura's social cognitive theory and Donald Schön theory of reflective practice.

3.1 Cognitivism

Cognitivists, such as Piaget (1952) and Bruner (1966) have had great impact on thinking about learning (Knowles, Holton & Swanson, 2012). They suggest that learners develop new ideas, concepts, assumptions and decisions based on their previous knowledge and how they interact with the world as an internal purposive mental process (Merriam et al., 2007). In health education, the concepts of cognitivism have simplified the important processes of clinical reasoning, decision making and problem solving (Merriam et al., 2007; Mann, 2011). Implementing cognitivism in peer-assessment requires the tutor to establish students' biases in order to present him/her with the new knowledge in context and at a suitable level of complexity (Knowles, Holton & Swanson, 2012).

Using peer-assessment as part of a cognitivist approach to teaching can create and facilitate access to experiences which facilitates learning (Taylor & Hamdy, 2013). In dental hygiene students are presented with cognitive and procedural conflict in a given experience such as (matrix band placement, insertion of composite restoration), drawing attention to the difference between what they expect according to their current knowledge, and the real experience

of the event (new knowledge). This is achieved by asking them questions and establishing a dialogic feedback (teacher and /or peer), in which they get to know that the new ideas are better than their previous knowledge. Peer-assessment is then fundamental and acts as a learning promote reemphasizing the disparity between students' actual knowledge and the level they need to achieve (Tricio-Pesce, 2014).

3.2 Social Constructivism

Vygotsky's social constructivism emphasizes the importance of social interaction in the learning process. The focus in this theory is on the way student's community supports learning. Learning will be more meaningful when students interact and engage in discussion with each-other in their classroom environment rather doing it alone (Taylor & Hamdy, 2013). Applying a peer-assessment activity in a dental hygiene pre-clinic creates a dialogue between peers, in their environment. This is destined to be more effective than working. Vygotsky (1978) emphasizes that learning occurs when learners interact with each-other using a similar language or "shared talk" (feedback). Thus, through dialogue ideas are ruminated, shared and developed.

3.3 Experiential Learning

Experiential learning theory is a holistic model of learning that suggests that "knowledge results from the combination of grasping experience and transforming it" (Kolb, 1984, p.41).

The experiential learning model is characterized by a four-stage learning cycle: concrete experience, reflective experience, abstract concept formation and active testing of concepts in new situations (Kolb, Boyatzis & Mainemelis, 1999). The experiential learning can start at any of the four stages (Kaufman, 2010). Dental health education involves a variety of teaching strategies and activities to assure and enhance student learning. These strategies involve higher levels of thinking and require students to use cognitive, psychomotor, affective and metacognitive skills.

Experiential learning activities are some of these learning and teaching strategies. Experiential learning/teaching activities such as problem-based and collaborative learning consist of collaborative education, workshop involvements, and classroom-based hands-on laboratory activities. These activities allow students to apply classroom learning to the real-world (Hmelo-Silver, 2004; Moore, 2007; Mueller-Joseph & Nappo-Dattoma, 2013; Canasi, Amyot & Tira, 2014). Kolb and Fry (1970) experiential learning model emphasizes that learning happens due to the amalgamation of emotional experiences with cognitive processes: conceptual analysis and understanding. Knowles et al. (2012) complemented Kolb's experiential learning strategies by underlining the critical importance of experience to learn and help to explain the gap between students' understanding something or simply having the knowledge and the competence to practice it. The best accepted aspects of Kolb's theory in medical education are the use of skills to test new knowledge, the opportunity to provide feedback during peer-assessment exercise to change students' practices (Kaufman, 2010).

3.4 Andragogy

Malcolm Knowles (1973) introduced the concept of andragogy, that is, adult learning. He argued that adults and children learn differently. According to andragogy, adults are self-directed individuals and as such take responsibility for their decisions (Merriam et al., 2007). In our dental hygiene program students range in age from 18-45 years old.

Andragogy as a model is associated to several educational, social, philosophical and psychological theories that were assembled by Knowles to explain that adults learn differently and have certain attitudes towards learning (Taylor & Hamdy, 2013). In andragogy, peer-assessment feedback is usually more important than tests and evaluations, and it should be

carried out in small amounts, with opportunity to obtain more if needed, in order to stimulate learning process (Knowles et al., 2012).

3.5 Reflective Practice Learning

Donald Schön's theory of reflective practice acknowledges that reflection is a crucial component of professional thinking as this is how health professionals deal with complex and ill-defined problems, and dental and other health professionals deal with this kind of situations in clinical setting (Tricio-Pesce, 2014). Schön's reflective practice learning theory in dental hygiene education explains what happens when reflective students interact with their patients: they are aware of their limitations, when they encounter challenging incidents; they invent solutions; then later they reflect on that particular situation; and finally reflect on how to behave in future when similar circumstances arise (Yardley, Teunissen & Dorman, 2012). Schön's "thinking on our feet" implies that learning happens when we critically reflect on our experience (Tricio-Pesce, 2014, p. 35). Thus, by establishing a mutual feedback dialog of reflection-in-action through peer-assessment process they learn from the feedback, change and therefore learn effectively (Knowles et al., 2012).

3.6 Bandura's Social Cognitive Theory

Students' self-regulating skills are improved when they participate in the assessment process allowing them to take ownership of their learning (Searby & Ewers, 1997). They develop a better understanding of their leaning process by analyzing their behavior (De Grez, Valcke, & Roozen, 2012). As they analyze their own behavior students become more self-efficacious. This skill is essential to a dental hygienist's ability and performance. Dental hygiene students not only should know what to do but also know how to do it (skills) such as periodontal debridement, restoring a tooth. An important aspect of self-efficacy for dental hygiene involves its predictive

capability. Determining how one perceives the ability to perform a behavior in a particular situation indicates the possibility of one actually performing the behavior. If the students think he/she can, and want to, he/she probably will.

Bandura's Social Cognitive Theory theoretical frame work best describes the relationship between motivation and success. Bandura (1986) defines self-efficacy as, "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances", (p. 391). The self-efficacy theory is engrained in that what people accomplish. It reflects what people believe they achieve rather than on what is objectively true (Bandura, 1997). Self-efficacy is more than just the ownership of skills and cognitive ability; it is the ambition and determination to make use of these skills requiring the use of cognitive, affective and self-regulatory skills (Bandura, 1997). Bandura (1994) believes that self-efficacy is developed through four main sources of experience. The first approach asserts that an individual may acquire a sense of self-efficacy via mastery experiences (the most dominant source). Successful experiences construct a beneficial sense of self-efficacy whereas failures undermine it, especially when they happen before a sense of self-efficacy has been firmly founded. The second approach maintains that enhancement of an individual's self-beliefs may be through vicarious or observational experiences offered by the social model. By the social model: when a student observes a social model (classmate) s/he believes to be capable to succeed at a given task under similar challenges. Social persuasion is a third approach whereby individuals may reinforce their belief in their ability to succeed. Self-efficacy beliefs are enhanced through verbal encouragements individuals receive from others as they communicate. These confident messages can be vital in encouraging one to put forth the extra effort and persistence needed to be successful eventually enhancing skills development and personal self-efficacy (Pajares & Urdan,

2006). The fourth approach relates to the individuals' somatic or emotional attitude regarding the ability to judge their capabilities. Physiological and emotional states such as anxiety, stress and fear may negatively affect self-efficacy. However, the self-efficacy is affected by one's interpretation of it and not by its intensity. Self-efficacious individuals regard emotions as revitalizing, whereas individuals with self-doubt may find them devastating (Pajares & Urdan, 2006). Such feelings may be interpreted by students as faulty indicators of the probability of failure.

Bandura (1986) associates high self-efficacy with enhanced performance. As such, incorporating pedagogical approaches in teaching and learning that enhance self-efficacy should undoubtedly enhance pre-clinical and clinical competence. Peer-assessment is one of these approaches. Feedback through peer-assessment in dental hygiene is a great source because the student can be convinced of having the ability to perform a behavior such as placing a rubber dam, a tofflemire and matrix band, inserting and carving a composite restoration through another peer telling them they are able to do it and/or improve it.

A key purpose of dental hygiene education is to graduate competent clinicians with adequate skills, knowledge, and responsibility for providing effective care to patients. As they progress through the program, dental hygiene students understand that being a professional requires lifelong learning, as science, technology, and standards of care evolve over time. Often faced with new situations, students must be aware of their own strengths and weaknesses and use self-awareness throughout their dental hygiene career to support a lifetime of professional achievement (Tuncer et al., 2015).

3.7 Purpose of assessment in higher education

Assessment is recognized as a crucial and vital part of the education process. It is not only important for the student but also for the teacher, the program, the institution, the accrediting body and the public as a consumer (Harden & Laidlaw, 2013). Assessment provides a window into what students know and how they are processing information. It affects students' lives as their future direction and careers depend on knowledge acquired (Boud & Falchikov, 2006).

Assessment can either be summative, to measure students' achievements, or formative, to enhance their learning (Tricio-Pesce, 2014). Summative assessment is known also as assessment *of* learning and is used to validate what students know for evidence-based decision making (Sadler, 2005). For example, it can be used to choose who is admitted or accepted to a particular program, to make decisions about our students' competence advancement at a particular level within their program, or to confirm whether students are competent enough when they complete the program and have attained the regulating bodies' expected standards (Light, Cox & Calkins, 2009; Harden & Laidlaw, 2012).

Assessment in higher education has generally been assessment *of* learning (Earl, 2012), as it is an important part of education, however Black and Williams (1998), have drawn attention to assessment *for* learning and how it influences student learning (Boud & Falchikov, 2006). Additionally, research from contemporary educational philosophies acknowledges that the main focus should be on assessment *for* learning than assessment *of* learning (Schuwirth & Van der Vleuten, 2011). The word 'assessment' originates from the Latin *ad sedere* or *assidere*, "to sit beside or with", and emphasizes the importance of a feedback component (Wiggins, 1993; Manogue et al., 2011).

The purpose of assessment is to provide official recognition of achievement (summative assessment) and to enable learning (formative assessment) (Boud & Falchikov, 2006).

3.8 Summative Assessment

Assessment is a fundamental part of all aspects of daily life. Summative assessment is known also as assessment *of* learning and is used to validate what students know for evidence based decision making (Sadler, 2005). To design and setup of a successful evaluation system is challenging. Health education programs that have a clinical component such as dental, dental hygiene, nursing and medical are concerned not only with knowledge acquisition, but also attainment of skills and their application. Miller's pyramid (1990), tries to explain how students in professions such as medicine and dentistry develop such skills (Taylor et al., 2013).

3.9 Formative Assessment

Formative assessment can be carried out by peers or by the teacher. Formative assessment and feedback is intended to encourage students to be self-regulated learners. More acknowledgment should be given to the role of feedback on learners' motivational beliefs and self-esteem (Juwah, Macfarlane-Dick, Mathew, Nicol, Ross & Smith, 2004). Successful feedback encourages self-assessment/reflection in learning, clarifies what good performance is compared to standards, provides great information to students about their learning, encourages self-esteem and motivational beliefs, creates opportunities to close the gap between the current and desired performance and encourages teacher-student discussion about learning (Garrison & Ehringhaus, 2007).

3.10 Peer-Assessment

Peer-assessment is an effective educational evaluation tool (Boud et al., 1999). It is "an arrangement in which individuals consider the amount, level, value, worth, quality or success of the products or outcomes of learning of peers of similar status" (Topping 1998, p. 250). Peer-assessment enhances student learning even when no grade is attributed to it (Liu &

Carless, 2006). Recent studies have shown that when novices receive thoughtful evaluations and comments by peers, they find the process powerful, insightful and helpful (Norcini, 2003).

Although students might be dubious about the peer-assessment procedure which seems to be questioning the credentials of their peers, it can be a worthwhile process.

This form of assessment is successful in courses or classes where students know each other well and have established relationships (Lurie, Nofziger, Meldrum, Mooney & Epstein, 2006).

As classes in the dental hygiene department have become more culturally diverse, peer-assessment helps address student needs and engages students from all backgrounds (Lurie, Lambert, Nofziger, Epstein & Grady-Weliky, 2007).

In summary, peer-assessment can be beneficial to promote learning if it (Falchikov, 2007 p. 139):

- Is designed as a learning experience
- Requires learners to take responsibility for their actions
- Involves providing, seeking and utilizing feedback
- Encourages a reflective approach to learning
- Requires students to identify and apply standards and criteria
- Provides some degree of modeling and/or scaffolding
- Is practiced in a variety of contexts

3.11 Benefits of Peer-Assessment

Dochy et al. (1999) reviewed 63 studies and suggested that the use of different new class evaluations forms such as peer-assessment inspires students to become more accountable and reflective as the process requires students to be unbiased and truthful with the judgments they make regarding their peers. Involving students in peer-assessment could be successful in any

discipline area and at any level (Falchikov & Goldfinch, 2000). Peer-assessment facilitates student involvement in their learning development and is greatly encouraged in the first year of higher education and beyond (Nulty, 2011). Research has shown that students are better able to explain information to a peer than the instructor can as they use a more comprehensible language and use a more sociable approach. Students are more open to criticism offered by a peer than that given by a teacher (Nicol & Macfarlane-Dick, 2006).

3.12 Students' Perception of Peer-Assessment

There are studies reporting views both in favor as well as against students' perception of peer-assessment.

In a study conducted by Strachan and Wilcox (1996), third-year geography students found self- and peer-assessment to be a beneficial and gratifying learning experience helping them with collaboration and communication skills. Similarly ninety-six second-year medical students reported that peer-assessment of each other's professional competence recognized more strength and weaknesses than their own self-assessment. Thirty-eight percent deemed these concerns to be a crucial part of their learning plan. In conclusion, 53% agreed that receiving peer-feedback was advantageous while 22% had mixed opinions or disagreements. Sambell, McDowell and Brown (1997) reported that social science students assert that self and peer-assessment allowed them to reflect and judge their work and that of other. Students did however express their concerns about judging friends. Some felt lacking in confidence to act as a fair assessor. The authors suggest careful arrangements and support for students to guarantee students' expectations of the peer-assessment implementation and the reality of what they actually experience are equivalent.

Beaumont, O'Doherty and Shannon (2011) reported another type of student negative perception with regard to peer-assessment. They conducted semi-structured focus-groups to investigate the

perception on peer-assessment of 37 students before entering university. A minority considered it as constructive and motivational while the majority reported a bad experience related to the level of expertise and reliability of peer-assessor as well as plagiarism concerns.

The effects of peer-assessment training on the performance of student teachers were reported by Sluijsmans, Brand-Gruwel and van Merriënboer (2002). Fifty students were trained in defining performance criteria, giving feedback and writing assessment reports while forty-three made up the control group and received no training. Students with training demonstrated higher quality assessment skills. Furthermore, trained students performed significantly better on subsequent tests than students from the control group. The authors concluded that students could be trained in assessment skills in order to positively increase their performance. In a different aspect of peer-assessment forty-two undergraduate medical students delivered and received anonymous feedback about their presentations on anatomy (Gukas, Miles, Heylings & Leinster, 2008). Research results concluded that the majority of students felt comfortable receiving and giving feedback. They found the process to be fair, satisfactory and helpful and surprisingly, receiving feedback made them reflect. However, if the anonymity was removed they would feel hesitant to give feedback.

Planas Lladó et al. (2014) conducted a study on the students' perceptions on a before and after peer-assessment process. Four hundred and sixteen students in 11 different subjects and 4 different fields appreciated the process before and after its implementation. They found the peer-assessment process motivating and believed it enhanced their learning abilities at different levels. This was not the case for 52 first-year engineering undergraduate students who didn't feel comfortable and lacked confidence in their abilities to assess their peers even though they

received thorough training. Despite the negativity, there was a positive move in both attitude and confidence after the peer-assessment exercise.

3.13 Limitations of Peer-Assessment

Peer-assessment has been shown to have beneficial possibilities however there are a number of boundaries. There is a vast amount of research reporting on “friendship marking” leading to in overmarking, and “collusive marking” ensuing in a lack of discrepancy within groups (Dochy et al., 1999; Evans et al., 2007; Cushing, Abbott, Lothian, Hall & Westwood, 2011). A study from Papinczak, Young and Groves (2007) reported the same concerns. Friendship marking and lack of honesty played an important role in the decision to prematurely withdraw medical students from the peer-assessment research in Problem-Based Learning. Medical student’s standpoints included: “I find it difficult to downgrade my peers”; “it is hard to criticize friends”; “no one wants to criticize others in PBL”; “most people are too afraid to honestly mark their peers” (p. 12). A combination of peer-assessment with self-assessment or co-assessment will alleviate or prevent these issues from happening (Dochy et al., 1999). An ill designed and implemented peer-assessment process or exercise will negatively impact students’ learning (Falchikov & Goldfinch, 2000). Utilizing a traditional norm-reference peer-assessment methodology does not prove to be beneficial to students (Falchikov, 2007). This concern has been noted in the medical field. Junior doctors found the use of a norm-reference peer-assessment scale quite difficult to assess peer’s workplace performance quality (Norcini, 2003). Similarly, Arnold (2002) suggested that asking students to peer-assess in all clinical routines could cause a “halo effect” (Gregory, 2004, p. 431) as students can be incapable of distinguishing between peer’s technical knowledge and skills and professional behaviours.

All the previously mentioned student concerns and issues with regard to peer-assessment could be alleviated and overcome if the process of implementation of the peer-assessment process was well thought out and carefully implemented (Sambell et al., 1997).

This may explain the reason why some teachers find the planning and implementation of the peer-assessment process to be demanding and time consuming (Hounsell et al., 2007).

Nevertheless, having the students input in the planning process and keeping in mind these concerns (Strachan & Wilcox, 1996), has been shown to ease and support peer-assessment implementation (Hounsell et al., 2007).

3.14 Direct Observation of Procedural Skills (DOPS)

Research has shown that dental schools have drastically changed their way of assessing students in medical and clinical knowledge. New methods were developed and implemented in order to assess students' clinical skills, such as taking patient's medical history, performing a physical examination, and performing procedural skills such as dental fillings (restorations) (Norcini & McKinley, 2007).

Direct Observational of Procedural Skills used as formative assessment is one of the new assessment methods. It's a variation of the mini-clinical evaluation exercise (mCEX) in which a different assessor observes the trainee while she/he is performing a procedure at least six times during the year. The assessor evaluates the performance such as giving an injection, inserting a tube, drawing blood, inserting and carving a restorative filling in amalgam/composite, and then gives feedback (Norcini & McKinley, 2007; Cantillon & Wood, 2010).

DOPS advantage is that it allows the trainee to directly assess pre-clinical or clinical procedures and provide mandatory immediate structured feedback and discussion (Cantillon & Wood, 2010). DOPS is more popular in Obstetrics and Gynecology (OBGY), Nursing,

Anesthesiology, Pharmacy, assessing colonoscopic skills of senior endoscopists (Linedecker et al., 2017; Barton, Corbett & van der Vleuten, 2012; Dabhadkar, Wagh, Panchanadikar, Mehendale, & Saoji, 2014; Kumar, Singh, Rudra & Pathak, 2017; Roghieh, Fateme, Hami & Hami, 2013).

DOPS in dentistry as a form of peer-assessment and peer-feedback was conducted by Tricio et al. (2015), in 2012-2013 to evaluate students' academic achievement and reflective skills at the King's College London Dental Institute during their final year. Then in (2015), Tricio et al. conducted a prospective pilot study on dental students' peer-assessment using DOPS at the King's College London Dental Institute within second year pre-clinical students and in the fifth year clinical setting.

There is no evidence of the use of DOPS in Dental Hygiene.

3.15 Research Question

- 1- Will peer-assessment significantly improve students' ability to create acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD)?

Chapter 4: Methodology

The aim of this study was to examine the impact of peer-assessment instudents' ability to create acceptable Class II composite restorations on tooth #15(MO) and # 46(MOD). Aquasi-experimental design was chosen as the most appropriate research approach. Two research groups were selected to assess the impact of pre and post peer interventions. Instruments used to collect quantitative and qualitative data are presented.

4.1 Participants

A convenience sample of twenty dental hygiene students (n=18 female and n=2 male) enrolled in the Winter 2018 Restorative Dentistry course at John Abbott College (JAC) comprised two groups all of whom consented to participate in this peer-assessment study.

Students characteristics in the experimental group (n=9 female and n=1 male) varied in age (20 to 31) and level of education (20% had recently completed high school, 50% had a previous college diploma and 20% had obtained a university degree).The control group (n=9 female and n=1 male), varied in age (19 to 38) and level of education (18.2% had recently completed high school, 9.1% had a previous college degree and 72.7% had attained a university degree).

4.2 Recruitment

A discussion was led by someone outside of the study (a faculty member of the dental hygiene department) to ensure students in Restorative Dentistry course comprehended the formative nature of their participation and that they understood it was not intended to harm their overall learning. Participants were informed they could withdraw from the study at any time and that it would not affect their academic standing.

Students were assigned to their lab sections Tuesday pm, Wednesday am and pm by the department's Dental Hygiene chairperson. Taking into consideration that time of day could possibly influence student learning, the two afternoon groups were chosen for the purpose of the study. The learners were informed of the aim of the research verbally and in writing prior to the commencement of the study.

The two groups were randomly divided into a control $n=10$ (no peer-assessment) and experimental group $n=10$ (peer-assessment).

4.3 Research Design

In order to ensure of internal validity, the content, theoretical format and teacher did not differ from last year's design. To eliminate teacher bias, a colleague, who had previously taught this course, corrected the anonymous pre-cognitive and procedural tests. As well she supervised both labs (control and experimental) during peer-assessment learning strategy implementation.

This study used a mixed method research design. Quantitative data analyzed the performance scores of the pre-cognitive test, pre-procedural test on a Class II composite restoration on tooth # 45(MO) and creation of two Class II composite restorations on tooth #15(MO) and # 46(MOD) between the control (no peer-assessment) and experimental group (peer-assessment) using the dental hygiene restorative lab evaluation rubric (see Appendix A). Students were asked to complete a confidential online qualitative survey adapted from Clinical Teaching Preference Questionnaire (Iwasiw & Goldberg, 1993) using a five-point Likert scale and three open-ended questions in order to examine their perception on peer-assessment instructional strategy use. The questionnaire included information from both groups regarding age, gender and prior education.

4.4 Purpose of the study

The aim of this study was to investigate the impact of formative peer-assessment in students when performing Class II composite restorations on tooth # 15(MO) and # 46(MOD).

The independent variable: peer-assessment strategy (IV).

The dependent variable: students 'mean scores on Class II composite restorations on tooth # 15(MO) and # 46(MOD).

4.5 Instruments

Quantitative data analyzed the effectiveness of peer-assessment on students' performance score in creating acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD). To assess the effect of the strategy of peer-assessment, the mean scores of rubber dam placement (six component performance checklist), tofflemire and matrix band placement (five components performance checklist) and final restoration (six components performance checklist) between the control and experimental groups were analyzed by using the dental hygiene restorative lab evaluation rubric (see Appendix A).

The qualitative part of the research consisted of eight questions adapted from Clinical Teaching Preference Questionnaire (Iwasiw & Goldberg, 1993) using a five-point Likert scale ranging from strongly agree to strongly disagree and three open-ended questions using an anonymous online survey to assess students' perception of peer-assessment practice trials. A brief demographic questionnaire requested information about age, gender and prior education for both groups (see Appendix B).

The three open- ended questions were:

1. How did peer-assessment improve or not improve your ability to perform a Class II restoration on a mannequin? Explain your answer.
2. What benefits or not have you found using the peer-assessment activity? Explain your answer.
3. Offer three thoughts on the peer-assessment learning experience. Explain your answer.

4.6 Peer-Assessment Procedure

Students constructed their knowledge on restoring a tooth in a classroom/laboratory setting as they practiced on a phantom head (Dexter) comprised of a typodont with 32 plastic teeth embedded in soft pink simulated gingival tissue. The teeth to be restored were pre-cut. The experimental and control groups performed self-assessment prior to any evaluation. The experimental group performed peer-assessment prior to teacher evaluation. Teacher, peer and self-evaluation rubrics were entered on separate colored sheets to avoid any bias during grading. Both groups were instructed on effective self-assessment procedures for rubber dam placement (a six components checklist) (week 1) and creating Class I composite restorations on tooth # 46(O) (a six components checklist) (week 2) using dental hygiene restorative lab self-evaluation rubric (see Appendix A). During week 3 and 4 the experimental group received additional instruction on how to effectively peer assess on two rubber dam placements (six components performance checklist) and creation of Class I composite restoration on tooth # 16(O) and Class I amalgam restoration on tooth # 46(O) (six components performance checklist) respectively. The composite restoration on tooth # 16(O) and amalgam restoration on # 46(O) were peer-evaluated anonymously at the beginning of the week 4 and 5 using dental hygiene restorative lab peer-evaluation rubric (see Appendix A).

During class time week five, participants completed a cognitive pre-test to determine their theoretical knowledge of Class II restoration procedures. The test consisted of ten multiple choice and four short answer/explanation questions. That same week, during lab time, a procedural pre-test required students to create a Class II composite restoration on tooth #45(MO). The procedures included were: placement of a rubber dam (six component performance checklist), tofflemire and matrix band placement (five components performance checklist) and insertion, finishing and polishing the final composite restoration (six components performance checklist).

Peer-assessment instructional strategy commenced on week 6 and 7 and after having placed their own rubber dam and completed self and teacher assessment students were assigned to peer evaluate rubber dam on tooth # 15(MO) and # 46(MOD) using self and peer evaluation restorative lab rubrics (see Appendix A). The same process for peer-evaluation was followed for tofflemire and matrix band placements.

The completed composite restoration on tooth # 15(MO) and # 46(MOD) were peer-evaluated anonymously at the beginning of the week 7 and 8 using dental hygiene restorative lab peer-evaluation rubric (see Appendix A).

Hence, the experimental group had twice experienced formative peer-assessment evaluation.

4.7 Ethical Considerations

A faculty member of the dental hygiene department outside the study explained and ensured that students participating in this study understood the formative nature and of their involvement.

Students were informed that their participation was voluntary and they could withdraw from the study at any time and that it would not affect their academic status (see Appendix D).

No compensation was given to the students for participating in the study. The pre-cognitive test was part of the course assessment plan. The composite restorations on tooth # 15(MO) and # 46(MOD) weekly lab tests performed during peer-assessment strategy were strictly formative and they were removed from the course assessment plan and did not affect their final grade. The two groups who did not receive the peer-assessment strategy received it in future lab sessions.

It was impossible for anyone reading the results of this study to be able to link any data with participants' name. The Restorative Dentistry course lab technician coded the participants' names with a fictitious number to ensure confidentiality from the rater and researcher during the development of the study.

The original list and the anonymous peer-assessment experiment results were locked in a filing cabinet in her office until the completion of the thesis

The completed study and its relevant documentation was stored on a password secured USB key and was put in safekeeping in the Finance and Legal Affairs department under lock and key and it will be destroyed after five years by the researcher.

Students were informed of the study's results during a later restorative lab session.

The study was conducted in a professional manner and its emphasis was on student learning.

The study received full ethical approval from John Abbott College's ethical committee, certificate number: JACREB201711

Chapter 5: Presentation of Findings

The aim of this study was to assess the the impact of peer-assessment on students ability to create acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD). Quantitative and qualitative data was collected from two research groups. To ensure equivalency of the two groups prior to initiating the study, the participants, completed a cognitive, a psychomotor and procedural pre-tests. A t-Test: Two-Sample Assuming Equal Variances was performed comparing the control and experimental group performance scores on pre-cognitive, psychomotor and procedural test; composite restorations on tooth # 15(MO) and # 46(MOD) including rubber dam and tofflemireand matrix band placements. Further, we performed a Two-sample t-test to verify if there was a statistical significant difference between the control and experimental group during the two week trial, in other words, to determine if peer-assessment had a positive impact of students' performance. To investigate students' perception of the peer-assessment procedure the answers of the experimental group from an anonymous online survey using a five-point Likert scale (strongly agree, agree, uncertain, disagree and strongly disagree) and three open-ended questions were analyzed.

5.1 Results

A total of ten second year students (9 female and 1 male) participated in the peer-assessment study (experimental group) and they peer-evaluated each other on two rubber dam placements (10% each), two tofflemireand matrix band placements (10% each) and two Class II composite restorations on tooth # 15(MO) and # 46(MOD) (10% each).

5.2 Quantitative Data Analysis

The pre-test mean and standard deviation scores for both groups using a Two-Sample t-test are presented in Table 1.

Table 1

Pre-tests Mean, Standard Deviation and Two-sample t-test coefficients results

Variables out of	Experimental group n=10		Control group n=10		Difference between research groups	
Test	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>T</i>	<i>p</i>
Pre-cognitive out of 36%	33.2	1.7	32.6	3.08	1.7	0.3
Pre-procedural out of 10%	7.3	0.9	7.3	1.2	1.7	0.5

Table 1 showed that there was no statistical significant difference in the pre-cognitive ($p=0.3$) and pre-procedural and psychomotor test on ($p=0.5$) between the two groups. Performance grades were compared following the first peer-assessment trial, rubber dam, tofflemire and matrix band placements and final composite restoration on tooth # 15(MO) (see table 2).

Table 2

Mean, Standard Deviation and Two-sample t-test coefficients on rubber dam, tofflemire and matrix band and final composite restoration tooth # 15(MO)

Variables out of 10%	Experimental group n=10		Control group n=10		Difference between research groups	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>T</i>	<i>p</i>
Rubber dam	9.9	0.3	9.9	0.3	1.73	0.5
Tofflemire and matrix band	8.5	3.2	10	0	1.73	0.088
15(MO)	4.4	3.61	7.1	1.37	1.73	0.025

The results on Table 2 showed no statistical significant difference ($p=0.5$) on the rubber dam placement. The control group performed better than the experimental group on tofflemire and matrix band placement however, there was no statistical significant difference between the groups ($p=0.088$). The students' first attempt to create a Class II composite restoration on tooth #

15(MO) showed that the control group outperformed the experimental group with a statistical difference of ($p= 0.025$).

The second rubber dam placement results on tooth # 46(MOD) showed no statistical significant difference ($p=0.14$) between the groups (see table 3). The mean scores of tofflemire and matrix band placement on tooth # 46(MOD) were identical for both groups and as a result the statistical significance was unmeasurable (see table 3). No statistical significant difference ($p=0.44$) was reported on final composite restoration on tooth # 46(MOD) between the two groups.

Table 3

Mean, Standard Deviation and Two-sample t-test coefficients on rubber dam, tofflemire and matrix band and final composite restoration on tooth # 46(MOD)

Variables Out of 10%	Experimental group n=10		Control group n=10		Difference between research groups	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>T</i>	<i>P</i>
Rubber dam	9.7	0.45	9.9	0.3	1.73	0.14
Tofflemire and matrix band	10	0	10	0	1.73	#NUM!
46(MOD)	6.1	2.1	6.3	3.3	1.73	0.44

5.3 Qualitative Data Analysis

To isolate the effect of peer-assessment on students' ability to create acceptable Class II composite restorations, the study investigated students' perception on peer-assessment benefits during the two-week trial. Separate analysis addressed each of the answers to the eight questions using a five-point Likert scale (strongly agree, agree, uncertain, disagree and strongly disagree) and three open-ended questions. Results are presented in figures 1-11.

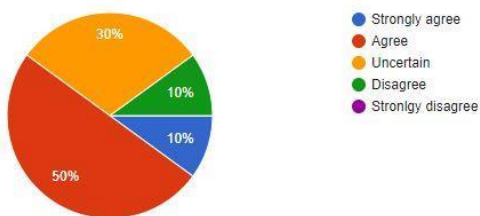


Figure 1. Answers on # 1- I feel freer to approach my instructor for help than I do my peers

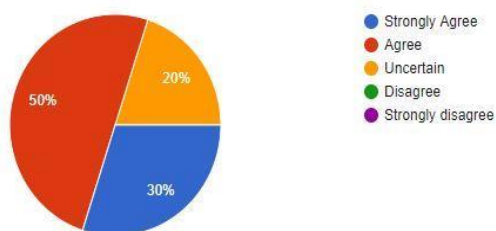


Figure 2. Answers on # 2- My ability to problem solve improves more from instructor feedback than from my peers

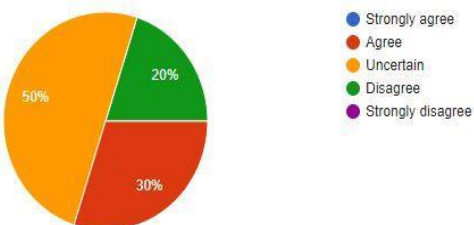


Figure 3. Answers on # 3-Being assessed on procedural skills by my peers increases my interaction and collaboration with other students more than when being taught by my instructor

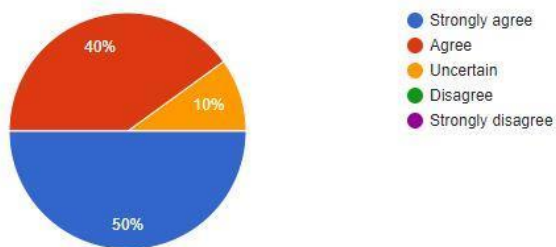


Figure 4. Answers on # 4- Being assessed on procedural skills by my instructor increases my sense of responsibility more than by being taught by my peers

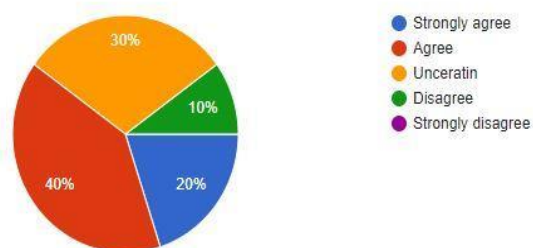


Figure 5. Answers on # 5- I learn more from my instructor than from my peer

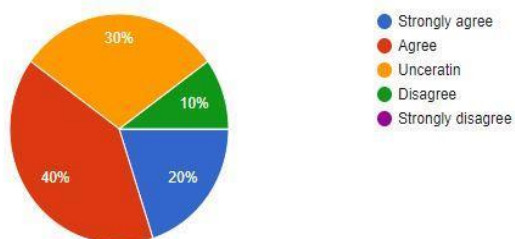


Figure 6. Answers on # 6- I can communicate more freely with my peers than with my instructor

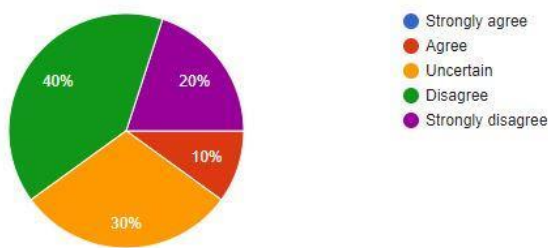


Figure 7. Answers on # 7- The feedback I receive from my peers is from a student's view, therefore more honest, realistic and helpful than from my instructor

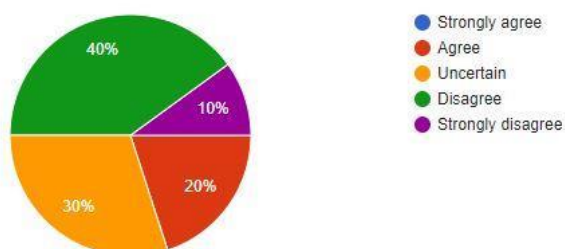


Figure 8. Answers on # 8- I am more self-confident and able to perform independently because of being taught by my peers, more so than by my instructor

Overall, the answers to the eight questions indicated that students had mixed perceptions regarding peer-assessment protocol. The majority of students prefer teacher feedback to that given by a peer. Fifty percent of the students felt more comfortable asking the teacher for help and the same percentage think that the ability to solve problems is better when given by the instructor. Forty percent of the students agreed that they communicated more freely with their peer than with the teacher.

The three open-ended questions were analyzed as follow:

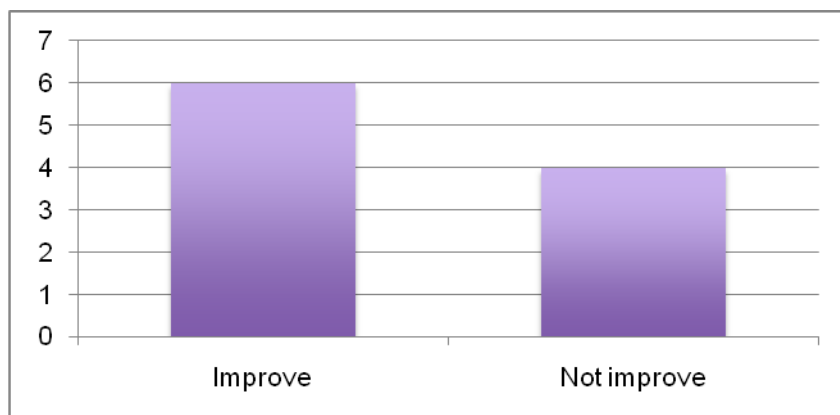


Figure 9. Question # 1- How did peer-assessment improve or not improve your ability to perform a Class II restoration on a mannequin? Explain your answer.

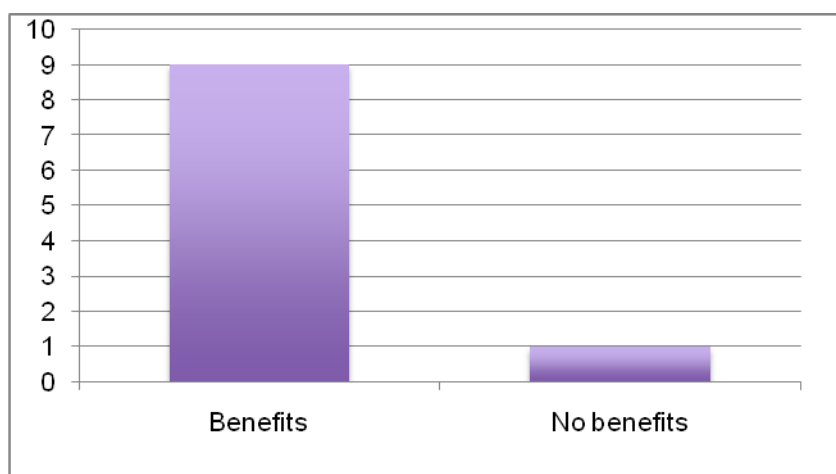


Figure 10. Question # 2- What benefits or not have you found using peer-assessment activity? Explain your answer.

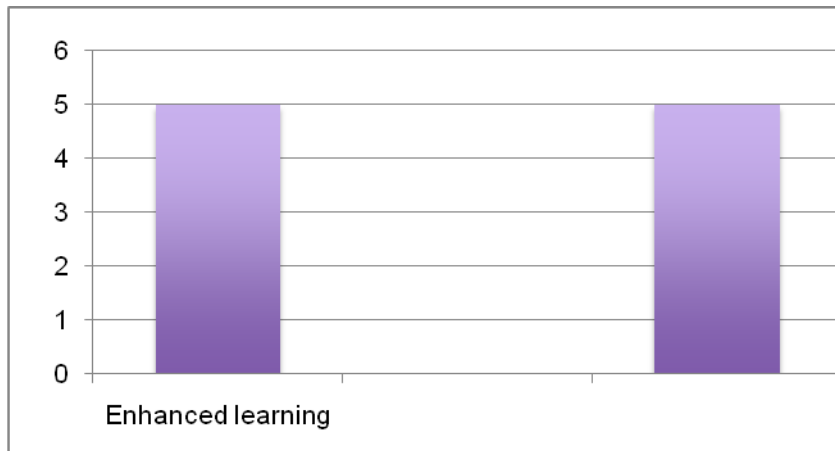


Figure 11. Question # 3- Offer three thoughts on peer-assessment learning experience. Explain your answer.

Reviewing the answers to the open-ended questions it was noted that students had more positive thoughts towards them compared to the eight survey questions. However, when asked if peer-assessment enhanced their learning students were equally divided, 50% reported that peer-assessment improved their learning while the other 50% said it did not.

Chapter 6: Discussion

The present study was designed to examine the impact of peer-assessment on students' ability to create acceptable Class II composite restorations on tooth # 15(MO) and # 46(MOD). To accomplish this objective pre and post-test were conducted. The performance scores of two research groups were compared on pre-tests. The data analysis showed that there was no statistical significant difference between the pre-cognitive and pre-procedural tests among the two groups. A t-test was performed to compare the performance of groups on rubber dam, tofflemire and matrix band placements and final composite restorations on tooth # 15(MO) and # 46(MOD).

The results showed that peer-assessment did not significantly improve students' ability to create acceptable Class II composite restorations on tooth #15 (MO) and # 46(MOD). Consequently, this study accepted the null hypothesis because there was no statistical significant difference in the performance mean scores between the control group (no peer-assessment) and experimental group (peer-assessment).

A possible explanation might be explained by the short time (two weeks) that the experimental group had to gain experience as evaluators. These findings are consistent with those of other studies who suggested that students need more time to gain experience as evaluators (Karl, Groef, Wichman & Beck, 2011); (Tricio et al., 2015) and adjust to the learning environment (Schöenrock-Adema, Heijne-Penninga, van Duijn, Geertsma & Cohen-Schotanus, 2007). Effectively the answers on students' perception on peer-assessment use suggested that they found it:

"Complicated, time consuming, not very helpful"

"I don't think that we knew enough about what we were doing to properly evaluate ourselves or our peers".

Further, whilst not statistically significant (probably due to sample size) both groups scored almost the same on week 2 of the peer-assessment trial (rubber dam $p=0.14$, tofflemire and matrix band was identical, final composite restoration on tooth # 46(MOD) $p=0.44$) and the experimental group showed a great improvement on performance scores compared to week 1. It seems possible that these results were also due to the limited numbers of the peer-assessment encounters (twice) and it's not in agreement with the conclusion of Williams, Klamen and McGaghie (2003), in that a minimum of seven to eleven encounters were required for reliable findings. However, students did benefit from the peer-assessment strategy as was supported by their feedback to the open-ended questions:

"It was good to get feedback from my peers on my tofflemire and matrix band, it helped in preventing improper contacts"

"Encourages the student to engage more and focus on their skills"

"Maybe helpful for tofflemire and matrix band, because peer can notice some problem before teacher"

Moreover, from students' perception on peer-assessment was found that they felt more comfortable on week 2.

"It improve communication and more enjoyable"

"Helped to see what is required for a good completion of a class 2 restoration".

Another possible explanation was the small size ($n=10$), meaning that care should be applied when trying to generalize.

It is important to bear in mind that with a small size, low number of training time and low number of peer-assessment encounters, caution must be applied as these findings cannot be generalized. These results were not very encouraging however it was the first peer-assessment implementation in dental hygiene education. There were areas of strength and challenges in this study. Students' comments on the strengths were:

"Encourages student responsibility and makes a student focus on their skills to perform the task well and encourages students to reflect on their own role"

"This improve communication between students"

"We can all share what we excel at with one another"

Students' comments on the challenges:

"I feel like peer-evaluation can sometimes not be accurate depending on who the peer is (ex: a friend) "

"They may not want to be honest in fear of hurting ones feelings"

"If the peer is someone who is not a close friend and just an acquaintance; I feel that they would be more honest"

Further studies, which take these variables into account, will need to be undertaken in the dental hygiene field to address the barriers and concerns expressed by the students and faculty.

Chapter 7: Closing Statement

Innovative teaching methods that include real-life scenarios are needed if educational institutions aim to graduate dental hygienists who are prepared to provide safe and efficient care. Traditional lecture format alongside limited pre-clinical experience can bestow technical knowledge however it does not adequately prepare graduates given the complexities of the current health care arena (Kneebone, 2002).

That is why the objective of the current study was to examine the impact of peer-assessment on student ability to create acceptable Class II composite restorations on tooth #15(MO) and #46(MOD).

This research has shown that peer-assessment strategy implementation in the Restorative Dentistry course in dental hygiene program at JAC did not significantly improve student ability to perform two Class II composite restorations. This is the first time that peer-assessment has been used to explore its impact on students' success in dental hygiene. Whilst this study did not confirm the positive impact of peer-assessment on the achievement of performance scores, it did partially substantiate the benefits of peer-assessment use when creating Class II composite restorations, based on students' perceptions.

Several limitations to this study need to be acknowledged. The sample size was small and the number of peer-evaluation trials and encounters was insufficient and not pertinent to this kind of study. These limitations suggest that this study findings need to be interpreted cautiously and not generalized. The author suggests that future peer-assessment research in dental hygiene should include a larger sample size, more practice and more peer-assessment trials to ensure consistency.

Further research in the dental hygiene field would be of a great help to investigate the impact of peer-assessment in students' active learning.

Being aware of the wide theoretical and practical background of peer-assessment from other areas of education provides encouragement and reinforces the further study of peer-assessment for dental hygiene students as a possible learning experience.

Moreover, by actively assessing and providing feedback to each other in a social constructivist model (stressing social interaction), they had to 'share what they know, what they don't know, relate it to previous pre-clinical experiences and apply it to the current simulation. As a result, they learnt by awakening developmental processes that only activate when interacting with their peers (Vygotsky, 1978). Further, the feedback was timely and immediate which is an important factor for effective feedback, particularly for novices who need to learn things quickly, in context, and when still engaged with the task (Ladyshevsky, 2010).

The social interaction during peer-assessment can transform pre-clinical experiences into reflective learning. This is an important attribute for dental hygiene practitioners who deal with complex professional contexts such as exponential new knowledge and treatment possibilities, more stringent and informed multicultural patients in an increased multidisciplinary focus of practice (Koole et al., 2013).

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Appendix A

Dental Hygiene Restorative Dentistry lab Self/Peer/Teacher Evaluation Rubric



DATE: _____ NAME: _____ TASKS: _____

Self-Evaluation done BEFORE teacher and peer-evaluation

		Q	Q	Be specific:	
RUBBER DAM (1-3 points may be removed for each criteria)	*Floss on clamp and frame				1-ORGANIZATION AND TIME MANAGEMENT WILL BE OBSERVED AT ALL TIMES, 1(one) POINT MAY BE DEDUCTED FROM ANY OR EACH OF THE TASKS 2-ALL * CRITERIA MUST BE MET OTHERWISE A GRADE OF 0/10 WILL BE RECEIVED. IF A GRADE OF 0/10 IS OBTAINED FOR EITHER: 1) THE LINER, 2) TOFFLEMIRE and MATRIX BAND AND/OR WEDGE, IT (THEY) MUST BE REDONE CORRECTLY BEFORE PROGRESSING TO THE RESTORATION. (THERE WILL BE NO GRADE AUGMENTATION.) 3- ERGONOMICS MUST BE OBSERVED AT ALL TIMES, 1(one) POINT DEDUCTION MAY BE DEDUCTED FROM ANY OR EACH OF THE TASKS 4-A / C: AMALGAM OR COMPOSITE
	*Clamp stable and centered (does not impinge dam/gingiva)				
	Field of isolation is correct				
	Dam is inverted				
	Dam is tight around each tooth				
	Dam is free of tears and folds				
	MARK	/10	/10		
PULPAL PROTECTION	Material: Dycal, Glass Ionomer, IRM	Tooth	Tooth		
	*Only dentinal surfaces covered, no enamel				
	*Smooth and even (free from scratches, lumps)				
	MARK	/10	/10		
TOFFLEMIRE and MATRIX BAND	*Extends 0.5-1.0mm below gingival floor				
	*Extends 1-1.5mm occlusal to marginal ridge				
	*Well wedged				
	*Contact area correctly burnished				
	*Secure around tooth and secure within retainer				
	MARK	/10	/10		
RESTORATION (1-4 points may be removed for each)	Restorative Material used:	A / C¹	A / C¹		
	All anatomical landmarks present				
	*Free of ditches				
	*Contact area properly re-created				
	Free of overhangs				
	Free of flash				
	Restoration smooth, polished				
	MARK	/10	/10		

Appendix B

Anonymous Demographic Survey & Clinical Teaching Preference Questionnaire

Anonymous Demographic survey

Age			
Gender			
Years of education	High school ()	College degree ()	University degree ()

Anonymous survey: 8 questions using a five point Likert scale

Item	Preference items	Strongly agree 5	Agree 4	Uncertain 3	Disagree 2	Strongly disagree 1
1	I feel freer to approach my instructor for help than I do my peers					
2	My ability to problem solve improves more from instructor feedback than from my peers					
3	Being assessed on procedural skills by my peers increases my interaction and collaboration with other students more than when being taught by my instructor					
4	Being assessed on procedural skills by my instructor increases my sense of responsibility more than by being taught by my peers					
5	I learn more from my instructor than from my peer					
6	I can communicate more freely with my peers than with my instructor					
7	The feedback I receive from my peers is from a student's view, therefore more honest, realistic, helpful than from my instructor					
8	I am more self-confident and able to perform independently because of being taught by my peers, more so than by my instructor					

Three open-ended questions will examine themes and patterns and report on the findings.

- ✚ How did peer-assessment improve or didn't your ability to perform a Class II restoration on a mannequin? Explain your answer.
- ✚ What benefits or not have you found using the peer-assessment activity? Explain your answer.
- ✚ Offer three thoughts on the peer-assessment learning experience. Explain your answer.

Appendix C
Certificate of Ethics Approval



CERTIFICATE OF ETHICS APPROVAL

Name of Applicant: **Anila Hasko**

Institution: **John Abbott College**

Title of Project: **The impact of peer- assessment on fourth semester dental hygiene students' ability to create an acceptable Class II restoration.**

Certificate Number: **JACREB201711**

Valid from date to date: **October 27th, 2017 - October 27th, 2018**

Email: :

The members of the John Abbott College Research Ethics Board have examined the application and consider the experimental procedures as outlined by the applicant to be on acceptable on ethical grounds for research involving human participants. A final report summarizing the findings should be submitted to John Abbott College within six months of the completion of the study. This approval of research ethics does not guarantee that CEGEP John Abbott College will provide access to any institutional services, such as Data Mining.

Co-Chairs: **Laura Shillington and Shireef Darwish**

Appendix D

Student's Consent Form

Title of the project

The impact of peer-assessment on dental hygiene students' ability to create acceptable class II composite restorations.

Researcher:	AnilaHasko	
Email		
Dept	Dental Hygiene	
Supervisor:	Dianne Bateman	

Dear Student:

You are being asked to participate in the above research study in which we are investigating the impact of peer-assessment when creating an acceptable Class II composite restoration.

Research Question

1. Will peer-assessment increase significantly students' ability to create an acceptable class II restoration?

Purpose of the research:

The purpose of this study is to investigate the impact of peer- assessment on fourth semester dental hygiene students' ability to create an acceptable class II restoration in the laboratory section of the Restorative Dentistry course.

What is involved in participating?

You have learnt theoretical concepts of different dental materials in Prosthodontic course and in the Restorative Dentistry course you will learn the manipulations of these dental materials. You will be asked to watch different instructional videos on different restorative procedures as well as lectures will provide the theory while laboratory sessions will ensure practical experience.

You will watch the videos prior to lecture/lab and create study notes. You will construct your knowledge on restoring a tooth in a classroom/laboratory setting as you practice on a phantom head (Dexter) with a 32 plastic teeth and soft pink gingiva typodont.

The teeth that will be restored are already precut. Students will change virgin teeth from the typodont with the precut one according to the weekly schedule at the beginning of each lab or at the end of the previous lab if time permits. Experimental and control group will perform self-assessment prior to any assessment. Self, peer and teacher evaluation rubrics are done in separate sheets to avoid any influence during grading. Students in the experimental group will receive two

weeks of training (week 3-4) on peer-assessment as they place rubber dam (a six components checklist) and performing Class I amalgam restoration on tooth # 46(O) and Class I composite restorations on tooth #16(O) (a six components checklist). Final restorations tooth # 46(O) and # 16O (six components performance checklist) will be evaluated anonymously at the beginning of the next lab due to time restriction, using dental hygiene restorative lab evaluation rubric.

A pre-cognitive test will be given to both groups (whole class) as part of your assessment plan on week five. Also, as part of your weekly requirement, a procedural pre-test will be given to both groups consisting of creating a Class II composite restoration on tooth # 45(MO), which includes the procedures of rubber dam placement (a six components checklist), tofflemire and matrix band placement (five components performance checklist). The final restoration (six components performance checklist) will be evaluated anonymously at the beginning of the next lab due to time restriction, using dental hygiene restorative lab evaluation rubric. Only the contacts between mesial surface of tooth #15 and distal surface of tooth # 14 will be checked during lab time.

Formative peer-assessment learning strategy will start on week 6 and 7 and it'll be done on creating a Class II composite restorations on tooth # 15(MO) and # 46(MOD), following the same steps as you performed on tooth # 45(MO). At the end of the peer-assessment strategy you will be asked to complete an online survey to assess your perception on this new learning activity. Your answers will be collected by the dental hygiene chairperson and coded to ensure confidentiality.

The results of the formative peer-assessments and your academic standing in previous dental hygiene courses may be used in this study.

There will be no way for anyone reading the results of this study to be able to link any data with your name or student number. PSEUDONYMS WILL ALWAYS BE USED in any publications that may result from this study, as well as in the stored data. If you withdraw from participation as a participant at a later date, all data of any kind will be erased and/or destroyed.

Participation, or lack of participation in this research will NOT affect your grades in any way. Your participation is entirely voluntary and you may choose to withdraw at anytime.

Confidentiality means that no person at John Abbott College, or any other organization will have access to the materials collected and that they will be coded and stored in such a way as to make it impossible to identify them directly with any individual. All names will be changed in the stored data and resulting publications. Data will be stored on a password secured hard drive, and will be destroyed after 5 years. All other type of information (audio-tapes, cd's, paper copies) will be stored in a locked filing cabinet and will be erased and/or destroyed after 5 years.

Student's signature:**STUDENTS: please tick the appropriate box, sign, date and return to ...**

I have read and understood the information provided on the consent form, and I agree to participate in this study. I understand that my participation is voluntary, I may withdraw from participation at any time, and my academic standing will NOT be affected in any way by consenting or not consenting to participate in this study.

I do not consent to participate in the described study.

Student's name (print):

First name, Last name

Student's signature: _____ Date: _____
signature dd / mm / yyyy

Researcher's signature: _____ Date: _____
signature dd / mm / yyyy

IF STUDENT IS UNDER THE AGE OF 18, PLEASE FILL OUT THIS SECTION AS WELL:

I have read and understood the information provided on the consent form, and I agree that my daughter or son may participate in this study. I understand that their participation is voluntary, they may withdraw from participation at any time, and their academic standing will NOT be affected in any way by consenting or not consenting to participate in this study.

I do not consent for my daughter or son to participate in the described study.

Parent's or legal guardian's name (print): _____
First name, Last name

Parent's or legal guardian's signature: _____ Date: _____
signature dd / mm / yyyy

Researcher's signature: _____ Date: _____
signature dd / mm / yyyy